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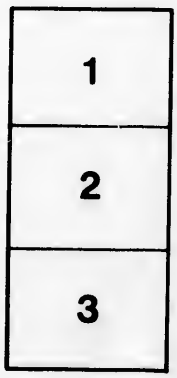

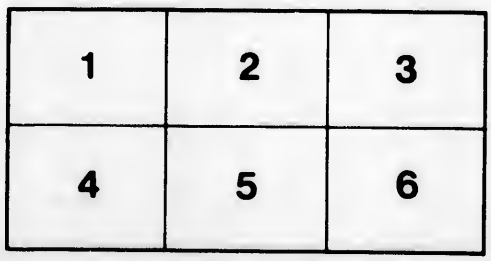

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BULLETIN OF THE GEOLOGICAL SOCIETY OF AMERICA
VOL. 2, PP. 165-176

NOTE ON THE GEOLOGICAL STRUCTURE OF THE SELKIRK RANGE

BY

GEORGE M. DAWSON
ASSISTANT DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA

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BY GEORGE M. DAWSON, ASSISTANT DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

(*Read before the Society December* 29, 1890.)

CONTENTS.

INTRODUCTION.

General Features of the Cordillera.—The Cordillera, or Rocky Mountain region of the Pacific coast, for a length measured by seven degrees of latitude in the southern part of the province of British Columbia, is narrower than elsewhere, having in this part of its course a width not much exceeding 400 miles. The principal geographical features of this southern portion of the Cordillera in British Columbia are now pretty well known, and the general geological outlines have also been drawn in, so far as this can be done from reconnoissance work. The districts which have been more closely studied are few and limited in size.

Enough is known to show that this part of the Cordillera offers a geological problem of great complexity, such as to require for its solution, even

under the most favorable circumstances, long and careful research. In addition to the difficulties of structure to be expected in any great mountain system, special difficulties are found in the degree to which regional metamorphism has been carried, in the occurrence of great volumes of contemporaneous volcanic material at various stages, and (partly no doubt as a consequence of the last) in the extreme paucity of fossil remains. Still further, the circumstance that the region as a whole must be described as more or less densely wooded, contrasts it very unfavorably, from a geologist's point of view, with the southern and open parts of the Cordillera, where he who runs may read many of the main structural facts.

Up to the present time the horizons which have in British Columbia been actually fixed by paleontological evidence may be summarized as follows:

1. Tertiary (probably Miocene).
2. Cretaceous (various stages, probably extending from the Laramie as far down as the Neocomian).
3. Alpine Trias.
4. Carboniferous.
5. Silurian (*Halysites* beds).
6. Cambro-Silurian (Trenton-Utica and perhaps somewhat lower).
7. Middle Cambrian.
8. Lower Cambrian (*Olenellus* beds).

Of these horizons, all but the Miocene have been recognized in the Rocky Mountains proper, or eastern range of the Cordillera. On the coast no fossils definitely older than the Carboniferous have yet been detected. In the interior plateau, fossils referable to the Miocene, lower Cretaceous, Alpine Trias and Carboniferous have been rather sparingly found, while in the mountain region of the Gold system, including the Selkirk, Purcell, Columbia and other ranges, we are as yet almost entirely without paleontological evidence.

Surveys in the Interior Plateau Region.—The writer has been engaged for some time in a detailed examination of an area of about 6,400 square miles in the interior plateau region, the materials for a geological map of which have now been obtained and are in course of elaboration. In connection with this work, and more particularly to assist in explaining the complexities of the older rocks of this area, it became desirable to ascertain, so far as possible, the relations of these rocks to those of the Rocky Mountains proper, across which one line of section has already been carefully worked out by Mr. R. G. McConnell.

With this object in view a preliminary examination was made last autumn across the intervening Selkirk range, on the line of the Canadian Pacific railway. This examination was necessarily confined to the vicinity of the railway and still requires to be supplemented by much detail, to be obtained

only by mountain climbing, and by the study of a belt of some width on both sides of the line. As, however, we have heretofore been almost without information on the geological structure of the Selkirks, it is believed that the observations made may not be without interest, even though given subject to future correction in detail. This range, where it has been rendered easily accessible by the construction of the railway, has already become noted for its magnificent Alpine scenery, while some of its peaks and glaciers have become the subjects of serious exploration by well-known Alpine climbers from England and Switzerland.*

Geological Features of the Interior Plateau.—In that part of British Columbia which has been called the interior plateau the oldest stratified rocks are gneisses and mica-shists, which from their lithological character are assumed to represent the Archean. The relations of these to the overlying Paleozoic strata are best known on the eastern border of the plateau region, where they are frequently and well shown. With these crystalline schists occur certain old granitoid rocks, which may represent either portions of the schists in which the bedded structure has been obliterated or very ancient intrusions that, together with the enclosing crystalline schists, have subsequently been affected by heat, pressure and other agencies. Besides these there is in the same region at least one later series of distinctly intrusive granites, which is probably newer in date than most of the Paleozoic rocks. In the Coast range, on the western side of the interior plateau, a similar "complex" of crystalline schists and granites occurs, of which part at least may be of the same age with that just alluded to, though in this case some of the intrusive granites are known to be post-Triassic in date and others are later even than the Cretaceous.

Stratigraphy.

The General Section.—The section given in the first column of the annexed table represents the rocks met with near the eastern border of the interior

*Such geological indications for the Selkirks as have been published may be found in the following works:

Report on the Geology of the Country near the Forty-ninth Parallel of North Latitude, by H. Bauerman. This is the result of observations made in 1859-'61, in connection with the expedition engaged in fixing the southern boundary of British Columbia in these years, but was first published in the Report of Progress of the Geological Survey of Canada for 1882-'84.

Summary Report of the Operations of the Geological Survey for the year 1887, by Dr. A. R. C. Selwyn. This contains a brief note on the character of the rocks near Illecillewaet.

Explorations in the Glacier Regions of the Selkirk Range, British Columbia, by Rev. W. Spotswood Green; Proceedings of the Royal Geographical Society, vol. XI, 1889. Mr. Green here gives a short geological note (p. 167) and refers to the determination by Professor T. G. Bonney of some of the rocks brought back.

Notes on the Geography and Geology of the Big Bend of the Columbia, by Professor A. P. Coleman; Trans. Royal Soc. Can., vol. VII, sect. IV, 1889. In this paper the general geological character of districts visited by the author are described and the results of a petrological examination of a number of rocks are given.

Brief mention has also been made by the writer of the rocks of the Selkirks and neighboring ranges in Descriptive Sketch of the Physical Geography and Geology of the Dominion of Canada, 1884; Mineral Wealth of British Columbia (Annual Report Geol. Surv. Can., new series, vol. III); and elsewhere. A somewhat more detailed account has been given by him of the geology of a part of the western border of the Selkirks, resulting from a reconnoissance made in 1889 and published in 1890 in his Report on a Portion of the West Kootanie District (Annual Report Geol. Surv. Can., new series, vol. IV).

Provisional Comparative Table of Formations met with (1) in the eastern Border of the Interior Plateau of British Columbia, (2) in the Selkirk Range, and (3) on the western Side of the adjacent Portion of the Rocky Mountain Ranges.

	1. Section on Kootanie and Adams lakes.	2. Section in the Selkirk range on line of Canadian Pacific railway.	3. Section in the Rocky Mountains (west side of range; McConnell).	
	Feet.	*Feet.*	*Feet.*	
	6. Greenish and gray schists, with limestone ..... 2,000 5. Limestone or marble, with black, glossy argillites and some gray schists. . 2,500	Quartzites with gray schists and some limestone. Black shaly argillites, limestone and gray schists.	*Halysites* beds. Dolomites and quartzites ..... 1,300 or more. *Graptolite*-bearing shales. Black fissile argillites, with some limestone 1,500	Cambro-Silurian and Silurian.
Adams Lake series.	4. Chiefly greenish, with some gray schists ..... 4,050 3. Chiefly gray, with some greenish schists 8,550	*Selkirk series.* Gray schists and gray quartzites, with some quartzose conglomerate and interbedded blackish argillites, the last chiefly toward the base 25,000	*Castle Mountain group.* Greenish and gray calc-schists and greenish and reddish shales and slates, with some dolomitic limestone ..... 10,000 (probably).	
Nisconlith series.	2. Black shaly or schistose argillite, with some limestone ..... 1,000 or more.	*Nisconlith series.* Blackish argillite-schists and phyllites, generally calcareous, with some beds of limestone and quartzite 15,000	*Bow River series.* Dark argillites, with some quartzites and conglomerates, the latter particularly toward the summit. Base not seen ..... 10,000 or more.	Cambrian.
Shuswap series.	1. Mica-schists, gneisses and marbles ..... 5,000 or more.	*Shuswap series.* Gray gneissic rocks and coarse mica-schists ..... 5,000 or more.		Archean.

Here the thickness should be doubled.

plateau region and is based on observations made on Kootanie lake in the western flanks of the Selkirks, supplemented by a section found on and near Adams and the Shuswap lakes, about 150 miles to the northwest of the first-mentioned locality. The lowest rocks in this column are those referred to the Archean, the thickness stated being merely that known to occur on Kootanie lake. The rocks included in the Adams Lake series, consisting of gray and green schists, and forming so large a part of the entire thickness, have been merely referred in a general way to the Paleozoic. In their typical locality they appear to be distinctly traceable on their line of strike into contemporaneous diabase and diorite rocks, which are often agglomerates, and pass into volcanic ash rocks, where their constituents become finer. The peculiar lithological character (which, taken by itself, might be supposed to indicate that the rocks should be classed as upper parts of the Archean) of these Adams Lake schists is thus believed to depend chiefly on the dynamic metamorphism resulting from extreme pressure which has affected the volcanic components of the Paleozoic, where these have been included in the strict flexures of the mountain region of the Gold system. No direct paleontological evidence is, however, forthcoming with respect to the age of the rocks of this first column of the table.

The third column in the table represents Mr. McConnell's published section in the Rocky Mountains proper, in which certain horizons, ranging upward from the lower Cambrian, are definitely fixed by fossils. It was found, in working out the section in this part of the Rocky Mountains, that a considerable difference exists between the section of the eastern as compared with that of the western part of the range, the present width of which (whatever that originally occupied by the rocks composing it may have been) is about sixty miles only. The particular feature of this change which is interesting in the present connection is that observed in the Castle Mountain (Cambrian and Cambro-Silurian) group, which, although it is on the east essentially a limestone formation, is found on the west to consist in large part of greenish calc-schists and greenish and reddish shales and slates.* No granitic rocks or true crystalline schists are seen in any part of this section.

The section represented by the middle column in the table is that now obtained for the Selkirks. It occupies, geographically, as it does in the table, a position intermediate between that of the eastern border of the interior plateau and that of the Rocky Mountains. In this, as in the section given in the first column, no horizons have yet been fixed paleontologically, and the position given to the rocks therefore depends principally on the comparison of the section with that known in the Rocky Mountains proper. It is probable, from the composition and condition of the rocks, that they may yet be found to hold fossils; but in the meantime it is believed that the lithological

*Annual Report Geol. Surv. Can., 1886, pp. 24D, 25D.

resemblance of the formations to those met with in the Rocky Mountains is in itself sufficient to enable some important general conclusions to be arrived at respecting the rocks of the Selkirk range, while the analogy of the rocks of the Selkirks to those of the first section is also such as to afford some clue to the age of the formations represented in it.

The Shuswap Series.—The lowest crystalline, and presumably Archean, rocks largely represented in the western portion of this part of the Selkirk range are evidently referable to the Shuswap series of the first section. They consist chiefly of gray gneisses, varying from nearly massive to quite schistose, and in the latter case frequently having their division-planes thickly covered with glittering mica. They are both hornblendic and micaceous, but the last-named mineral usually preponderates. Orthoclase is apparently the most abundant feldspar, quartz is nearly always well represented and garnets are not infrequent. In many places nearly half the entire mass of the rocks exposed consists of intrusive or vein granite, with pegmatitic or graphitic tendencies.

The Nisconlith Series.—Overlying the basal holo-crystalline series in the Selkirk section is a mass of rocks of which the thickness is estimated at 15,000 feet. These are dark-colored and generally blackish argillite-schists and phyllites, representing various stages in alteration between true argillites and micaceous schists. The rocks are usually rather finely fissile, with glossy and sometimes wrinkled surfaces, but often with much minute yet visible mica on the division-planes. These planes are in some cases evidently due to cleavage, but are often true bedding-planes. The rocks are usually calcareous, and frequently hold thin layers of dark-bluish or black impure limestone, together with occasional layers of dark quartzite. The coloration is evidently due to carbonaceous matter, and pyrites crystals are very common in certain zones. The only notable diversity met with in this otherwise homogeneous mass of rocks is found towards the base, where (at the lower end of Albert cañon) a bed of pure blue-gray crystalline limestone thirty feet or more in thickness occurs, and a short distance still lower in the section, a series of beds over 1,000 feet in thickness, consisting chiefly of granular pale-gray quartzites. The quartzites are sometimes flaggy and generally more or less micaceous, and are interbedded as well as overlain and underlain by blackish micaceous argillites and layers of coarsely micaceous pale schists.

These rocks undoubtedly represent the Nisconlith series of the first column, of which no extended sections have yet been found in the interior plateau, while to the eastward they certainly correspond in the main with the Bow River series of the Rocky Mountains, for which a thickness of 10,000 feet was there ascertained, though the base of the series is never exposed in the Rocky Mountains.

The Selkirk Series.—Between the foregoing series and the next overlying mass of beds in the Selkirk section no distinct line of division, even of a lithological character, has been observed, there being apparently, on the contrary, a considerable thickness of passage beds, in which the dark schists of the lower series alternate with gray quartzites and gray glossy schists characteristic of the upper series. The estimated thickness of this overlying series is 25,000 feet; and of its rocks the higher central peaks of this part of the range, comprising mounts Sir Donald, Macdonald, Tupper, Hermit, Cheops, Ross peak and others, appear to be wholly composed. Lithologically, it consists of a great volume of gray schists and gray quartzites, which are occasionally somewhat dolomitic. The quartzites probably preponderate, and vary in color from nearly white to gray and greenish-gray, being seldom dark in tint. They often, however, weather to pale brownish colors and pass into coarse grits and fine-grained conglomerates; and these grits and conglomerates have become more or less schistose in structure as a result of pressure, which has also led to the development in them of much fine silvery mica. The schists vary in color from pale neutral-gray to greenish-gray, and from dull to silvery and lustrous, being in many cases apparently true sericite-schists. They are sometimes wrinkled and contorted, particularly on the east side of the main synclinal, where also they occasionally become coarsely micaceous. To the east of this main synclinal and beyond the great fault shown in the diagrammatic section (p. 174) they are more crushed and altered and more highly micaceous than elsewhere, probably as a result of the dynamic conditions to which they have been subjected in this region.

The rocks of this great series appear to represent the Adams Lake series to the west, while they undoubtedly correspond, at least in a general way, to the Castle Mountain group of the Rocky Mountain section on the east, for which group Mr. McConnell ascertained a minimum thickness of 7,700 feet, but found reason to believe that its total volume in the western part of the range approached 10,000 feet.

It will be understood from what has already been said that the line indicated between this and the underlying series in the Selkirks is based entirely on general lithological differences, while there is every reason to believe that a plane of division drawn to correspond with that between the Castle Mountain and Bow River series in the Rocky Mountains would lie several thousand feet above the recognized summit of the Nisconlith series in the Selkirks. In the Rocky Mountains, the lower Cambrian (*Olenellus*) fauna is known to be common to the lower part of the Castle Mountain and upper part of the Bow River series;* the separation being there made at the base of the distinctly calcareous upper part of the Cambrian, while certain rather characteristic quartz-conglomerates observed in the upper part of the Bow

*This fauna is known to characterize several thousand feet of the Castle Mountain series, and has been found as well about 3,000 feet down in the upper part of the Bow River series.

River series of the Rocky Mountains are paralleled by similar conglomerates which abound in the upper series of the Selkirks. No unconformity has been observed between the upper and the lower masses of strata in either place.

Though in the Selkirk section the lower of the two great series which have been described resembles the Nisconlith of the interior plateau so closely as to warrant extending the same name to it, the fact that the overlying member of the section differs considerably from the Adams Lake series of the interior plateau, while on the other side it probably represents not only the whole Castle Mountain group but also the upper part of the Bow River series of the Rocky Mountains, renders necessary the application to it of a provisional distinctive name. It is therefore proposed to refer to this rock-mass as the *Selkirk Series.*

General Relations of the Cambrian.—Regarded as a whole, we find reason to believe that the Selkirk section exhibits a great Cambrian formation which (by analogy with the Rocky Mountains) includes the lower part of the Cambro-Silurian and reaches down from it to and far beneath a horizon at which the *Olenellus* or lower Cambrian fauna has been found, with an aggregate thickness of about 40,000 feet.

The comparatively pure limestones of which the Cambrian of the eastern part of the Rocky Mountains is composed are replaced in the western part of that range by rocks largely clastic in origin. This change in lithological character appears to continue and to become still more marked and to be accompanied by increasing thickness in the Selkirk range. Much of the clastic material is silicious, and the introduction of an increased proportion of such material may be explained by considering it as a result of approach to the shore line of Archean rocks on the west. While the principal development of contemporaneous volcanic products, whether in the Paleozoic, Mesozoic or Tertiary, is confined to a region west of the local Archean axis, the writer is inclined to believe that a portion of the remarkable difference found to occur in the western extension of the Cambrian may be due to the inclusion in its rocks, on this side, of volcanic ash deposits or other fine-grained volcanic materials, of which the composition was such as to favor the subsequent production of sericitic or sericite-like schists.

Speaking generally, the great Cambrian formation of the Rocky Mountain and Selkirk ranges shows many points of resemblance to the Cambrian and so-called "Algonkian" rocks of Utah and Nevada, the resemblance being particularly close in some respects to the series shown in the well-known Wasatch section, in which more or less distinctly micaceous schists are also found. It is, further, not at all unlike the Cambrian of Wales, which, though the organic remains are chiefly confined to some upper beds, has a thickness of 25,000 feet and is believed to exceed this in Shropshire.* The provisional

* Text Book of Geology; Geikie, 2nd edition, 1885, p. 651.

estimate of the thickness of the Cambrian arrived at in the Selkirks is, however, greater than that elsewhere known.

In a late paper on the stratigraphical position of the *Olenellus* fauna,* Mr. C. D. Walcott has suggested that the Bow River series of the Canadian Rocky Mountains may be regarded as "Algonkian." He does not, however, appear to have been aware of the fact above alluded to, that the *Olenellus* fauna characterizes both the upper part of this series and the lower part of the Castle Mountain group. With this circumstance in evidence, together with the apparently complete stratigraphical conformity of the two series, the writer cannot but regard it as more in consonance with the conditions, so far as these are known, and therefore as more philosophical to include, for the present at least, the whole of this great conformable mass of rocks, to its base, under the name Cambrian. In Utah and Nevada, where Mr. Walcott's observations on the western Cambrian have chiefly been made, it seems that the beds classed as "Algonkian" likewise in general conformably underlie those in which the *Olenellus* fauna is known, the conditions being apparently in most cases similar to those here described. On the propriety of the use of the new term in regions with which he is not personally familiar the writer wishes to offer no opinion, but he may take the opportunity of stating that he has met with no rocks in Canada to which its application can at present be considered appropriate, either in the interest of precision in the expression of facts already ascertained, or because of the discovery of heretofore unrecognized relations as between the older formations.

So far as could be definitely ascertained in the course of the rather hasty examination upon which this paper is based, the lowest beds of the Cambrian in the Selkirks (seen not far east of Albert Cañon station) are in angular conformity to the Archean rocks (seen to the west of the same station). The actual junction, however, remains to be studied, as there is here a gap in the section on the line of railway. In the meantime it may be stated that, notwithstanding the appearance of conformity, there is reason to believe that a great break in time is here passed over; for, although coarse, glittering micaceous schists are found in some parts of the Cambrian, the rocks of the lower series differ markedly even from these in their completely crystalline character. The essential diversity in age of the two series is further shown by the circumstance that the highest rocks of the Archean here met with do not include the notably silicious beds, the calcareous gneisses and the marbles which characterize the upper parts of this system as exposed on Kootanie lake and near Shuswap lake. It is also found that the very numerous granitic veins which everywhere cut the Archean rocks do not enter the overlying Cambrian strata, while a large quantity of pale-pur-

* Am. Journ. Sci., 2nd ser., vol. XXXVIII, 1889, p. 32.

plish, slightly opalescent quartz occurring in the conglomerates and quartzites of the Cambrian seems undoubtedly to have been derived from the denudation of these very granitic veins.

Newer Rocks.—On the eastern side of the Selkirk range certain rocks occur which are supposed to be equivalent to the *Graptolite*-bearing shales and *Halysites* beds of the adjacent Rocky Mountains. As, however, the reference of these beds must as yet be considered doubtful, on account both of the absence of fossils and of the unusually disturbed character of this part of the section, nothing more need here be said respecting them.

The Devono-Carboniferous, Carboniferous, Triassic and Cretaceous strata entering into the composition of neighboring parts of the Rocky Mountains are nowhere seen in this part of the Selkirks.

Structure.

Respecting the structural features of the section as a whole, little need be added, as, in so far as these may be considered to have been determined, they are rather simple. The western part of the Selkirk range, for a width of about seventeen miles, is essentially composed of Archean and granitic rocks, which, it may be added, are continued to the west of this part of the Selkirks across the Columbia range for a further distance of about forty miles. These rocks often lie at low, undulating angles, though they are occasionally much contorted. Above these, to the eastward, is the lower member of the Cambrian which has been referred to as the Nisconlith series. This forms a synclinal, of which the western side lies at a low angle, while the eastern side is steep, the axis being found near Illecillewaet station. To the east of the synclinal is a rather sharp anticlinal, the summit of the dark-colored beds of the Nisconlith series passing out of sight on the eastern side of this fold near the 413th mile-post on the railway.

The next great synclinal, which coincides with the highest parts of the range, appears to have a transverse width of about thirteen miles. The rocks con-

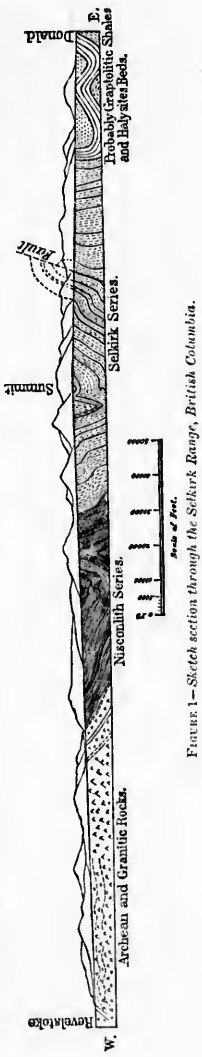

FIGURE 1.—*Sketch section through the Selkirk Range, British Columbia.*

tained in it are those of the Selkirk series, which is believed to represent the upper part of the Bow River series, together with the whole of the Castle Mountain group of the Rocky Mountain section. The position of the main axis of this synclinal nearly corresponds with Loop creek, on the railway, to the west of Glacier station, while a subordinate synclinal trough runs immediately to the east of the same station and nearly coincides with the actual watershed in the pass.

The eastern edge of this synclinal is believed to be bounded by a great fault, which is supposed to cut the line of railway near Cedar creek (about a mile and a half below Surprise creek) and to run on southward along the upper part of Beaver valley. This fault seems to have the character of a number of those found by Mr. McConnell in an adjacent part of the Rocky Mountains, viz., that of a fractured anticlinal, thrust up on the west side in consequence of pressure acting from that direction.

To the east of this great fault, the section shown in figure 1 must yet be considered largely hypothetical, as the structure here becomes more complicated and there is reason to suspect further extensive faulting. There are, however, grounds for the belief that, in a wide additional synclinal on this flank of the range, together with the repetition of a great part of the Selkirk group, still higher strata representing the *Graptolite*-bearing shales and the *Holysites* beds of the Rocky Mountains are included. The section ends on the east at the upper Columbia valley, the line of which is coincident with an important anticlinal exposing rocks of the Castle Mountain series, which dip westward into the base of the Selkirks and eastward into the opposite base of the Rocky Mountains.

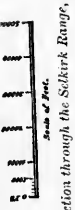

FIGURE 1.—*Sketch section through the Selkirk Range, British Columbia.*

Archean and Granite Rocks

THICKNESS.

If the writer is correct in attributing a total thickness of about 40,000 feet to the Cambrian (with such part of the Cambro-Silurian as may be included in the upper portion of the Castle Mountain group) of the Selkirk range, the entire thickness of the Paleozoic obtained by adding to this that of the remaining higher members of the adjacent part of the Rocky Mountains would be about 49,000 feet. Supplementing this with the thickness of the Kootanie and other formations of the Cretaceous, seen either in the Rocky Mountains or in the neighboring foot-hills toward the east, we obtain a total of 69,000 feet.

Though, however, the sections which give this enormous aggregate are all comprised within a distance, measured across the axis of disturbance, of little more than 100 miles, it is improbable that the whole of the beds in their maximum thickness ever formed a single column. The Cambrian evidently thickens greatly at its western margin, where not only has the upper part of the Paleozoic not yet been found, but where also there is reason to believe

that the very thick Cretaceous formations never extended. It must further be borne in mind that the actual width of 100 miles measured across this folded and faulted region represents a zone of very probably double this width of the surface as it was antecedent to the great folding and faulting. In this zone the line of maximum sedimentation appears to have moved progressively eastward, or away from the local Archean land, in the later periods.

DISCUSSION.

Dr. J. W. Spencer: I desire to again* claim priority for the name Algonkian, on the ground that before its publication I had used the term "Algonquin" to designate an episode in the Quaternary history of the region of the Great Lakes.

Mr. G. K. Gilbert: While the two names referred to by Dr. Spencer are based on the same root, one has the adjective form and the other the nominal, and confusion is thus avoided. The simultaneous and unobjectionable use of nouns and adjectives etymologically identical for different elements of geologic classification is illustrated in the case of the "Huron shale" and the "Huronian system," and in that of "Erie clay" or "Erie shale" and the "Erian period" or system. The use of "Erie shale" for a Paleozoic formation conflicts with the use of "Erie clay" for a Pleistocene formation, but neither conflicts with Sir William Dawson's term "Erian."

*Cf. Bull. Geol. Soc. Am., vol. 1, 1889, p. 238, note.

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